THE HEALTH OF THE SARITA WETLAND AS EVALUATED BY THE FUNCTIONS OF SOIL, WATER QUALITY, AND BIOLOGICAL ASSESSMENT

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Background

The Sarita Wetland is what remains of the drained Lake Sarita, and this region collects storm water runoff from the U of M campus, state fairgrounds, and other nearby residential areas. The water from the wetland eventually drains into the Mississippi River.

Fig. 1: A satellite view of the Sarita Wetland and surrounding area.

Nitrate is harmful to aquatic systems in high concentrations as it causes eutrophication of downstream water bodies. Therefore it is important to determine the effectiveness of the wetland soil in removing excess nitrate. These levels were monitored in a small scale mesocosm, along with conductivity and pH. Recently a sediment forebay was constructed, an intermediate pond between the storm water and the wetland, intended to reduce nutrient Inputs and the impacts of storm surges.

Fig. 2: (A) Left: The drainage ditch bringing water runoff to the wetland. (B) *Right:* Sediment forebay made to settle out sediments and nutrients before they reach the wetland proper.

Goals

To assess the functionality of the Sarita wetland based on nutrient processing, vegetative diversity, hydrograph variability and an overall index of wetland function (MnRAM).

Methods

Mesocosms: The experimental mesocosm (Fig. 3(A)) consisted of 4 inches of soil collected from Sarita above 13 inches of sand in a 100 gallon tank. A control (Fig. 3(B)) was also set up containing 17 inches of bare sand. Water with a nitrate concentration of approximately 23 mg/L was run through the tank for three hours, to allow for infiltration, using an aquarium pump. Excess drained through a hole 3 inches above the soil line.

The three parameters were monitored daily, and the experiment was conducted in two trials. Between trials the top layer soil was removed to eliminate possible nitrate deposits on the surface.

Additional data was taken directly from the wetland to establish the conditions present. The stability of the wetland was monitored through water level measurements. A well was Installed on site (Fig. 6(A)) which consisted of a vented

Methods cont.

Fig. 3: Mesocosms. *(A) Left:* experimental. *(B) Right:* control.

plastic pipe to ensure sediment was not entering the well the pipe was wrapped in landscaping fabric. This was staked in the wetland with a level logger hung in the water from the lid on the post and recorded every half hour. Sarita data was gathered using two standard techniques: the MnRAM 3.4 for evaluating wetland functions (1), which analyzes functions on a scale from 0-1, and the Floristic Quality Assessment (FQA) using the Wisconsin – Midwest Region, 2014 database (2), and calculating the mean coefficient of conservatism (C), on a 0-10 scale.

Fig. 4: Materials Used. *From left to right:* Aquarium Pump, Nitrate of Soda, HANNA Probe, PH Probe, Nitrate Probe.

Results & Discussion

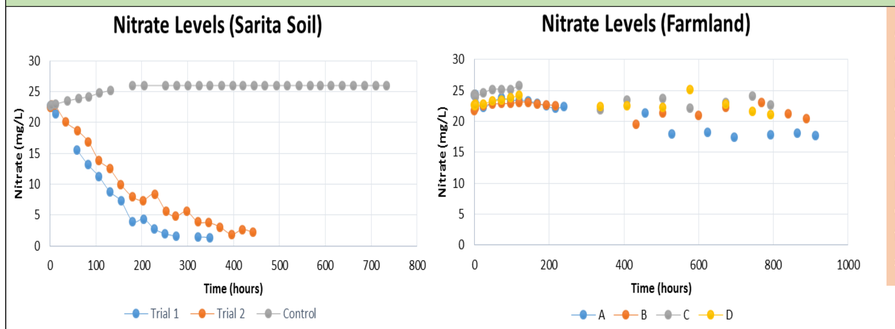

Fig. 5: (A) Left: The nitrate level data *(B) Right:* Data from mesocosms containing farmland soil (3)

The denitrification rates in the Sarita wetland soil are very high in comparison to the farmland soil (Fig. 5). This high functionality represented in the mesocosm data is supported by the low nitrate levels that are maintained in the wetland with concentrations measured at only 0.4 mg/L after rain and less than 0.1 mg/L under normal conditions.

The mesocosms indicated that the pH and conductivity of the water was independent of the soil composition as the experimental trend reflected that of the control. The sediment forebay had values of 0.7 mg/L and 0.1 mg/L respectively indicating its ability to settle out nutrients before they reach the wetland. Additionally, in the forebay pH and conductivity measurements were 8.63 and 300 µS/cm, respectively. In the wetland these measurements were 9.76 and 244 µS/cm. The forebay did help keep ions out of the wetland but the reason for the pH difference is currently unknown.

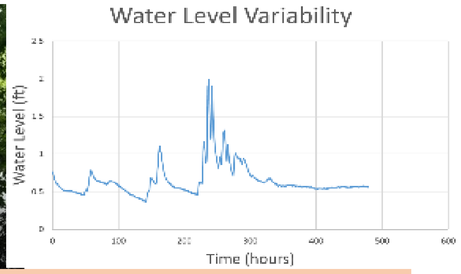

Fig. 6: (A) Left: The well. *(B) Right:* The resultant water level graph indicating high stability in water level and quick recovery after rainfall to original levels. This exhibits flashy behavior.

Based on the FQA the mean C is 1.3. Analyzing just the native plants, the mean C is 2.4. As a comparison, Woodview Marsh in 2013 (a degraded wetland meadow in Roseville, MN, post-restoration) has mean C values of 3.7 and 4.5 respectively. Sarita has a 55.2% native species population while Woodview has an 82.6% (4).

The MnRAM established most of the functions have a medium rating. Specific values are given in Fig. 7.

Results & Discussion cont.

Function Name	Rating	Category
Vegetative Diversity	0.18	L
Hydrology	0.40	M
Flood Attenuation	0.57	M
Water Quality (downstream)	0.45	M
Water Quality (wetland)	0.36	M
Characteristic wildlife habitat	0.50	M
Maintenance of characteristic fish habitat	0.34	M
Maintenance of characteristic amphibian habitat	0.60	M
Aesthetic/Recreation/Education/Cultural	2	E

Fig. 7: The results of the MnRAM 3.4 Assessment

Discussion

The Sarita soil has much greater denitrification rates than the farmland soil due to high organic content and low oxygen levels in the wetland (5). Plowing, harvesting, and fertilizers would decrease this functionality in farm soil.

The low FQA score is likely a result of the urban setting which increases runoff and causes flashy behavior, demonstrated by Fig. 6(B). This disturbance increases erosion and makes plant growth more difficult.

Based on the MnRAM which quantified functionality of the wetland, possible restoration activities could target those areas in need of improvement. The sediment forebay seems to have been an appropriate action due to the flashiness of the wetland (6).

Further Work

Sarita can be utilized by the University for education and research purposes. The FQA might be performed while plants are in bloom to increase accuracy. The long term hydrology in the wetland might be more closely monitored, as the level logger continues to collect data. The effects of the sediment forebay on the function and quality of the wetland could be investigated, as well as the causes of the high denitrification rates and the factors that influence this.

References

(1) MnRAM 3.4: For Evaluating Wetland Functions. http://www.bwsr.state.mn.us/wetlands/mnram/MNRAM_fulltext_9_2010.pdf

(2) Floristic Quality Assessment http://www.pca.state.mn.us/index.php/view-document.html?gid=18958

(3) Fasching, J. and Kramer, M. unpublished Mesocosm Data from experiments run at the Biosystems and Agricultural Engineering building, University of Minnesota

(4) Capitol Region Watershed District Wetland Assessment Report, 2007-2008

(5) White, John R., Reddy, K. R. Nitrification and Denitrification Rates of Evergades Wetland Soils along a Phosphorus-Impacted Gradient. http://soils.ifas.ufl.edu/wetlands/publications/PDF-articles/266.Nitrification%20and%20denitrification.pdf

(6) The Casperkill Assessment Group, Vassar College. Flashy Streams. Feb. 18, 2010. http://www.dutchesswatersheds.org/research-topics/83-flashy-streams

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